

Introduction:

Submerged Aquatic Vegetation Declines in the Chesapeake Bay

Worldwide, eelgrass (*Zostera marina*) abundance has declined significantly since the turn of the century due to pollution associated with increased human populations (Short and Wylie Echeverria, 1996) and episodic occurrences of the 'wasting disease' (Short et al, 1986; den Hartog, 1994). In Chesapeake Bay, deforestation, population growth, and the subsequent sedimentation and nutrient enrichment caused declines in all species of submerged aquatic vegetation (SAV) beginning in the 17th century (Brush and Davis, 1984). However, those changes were relatively minor compared to the catastrophic declines that occurred in the late 1960's and early 1970's (Orth and Moore, 1983).

Researchers suggest a combination of factors resulted in these losses. Kemp et al. (1983) and Twilley et al. (1985) postulated that increased nutrient loadings of the Chesapeake Bay in the 1970's enhanced growth of planktonic and periphytic algal species which compete with SAV for light. SAV productivity was shown to be reduced further when suspended sediment increases in the water column, exacerbating light attenuation problems (Wetzel and Penhale, 1983; Kemp et al., 1983). These studies demonstrated that SAV growth and abundance were inextricably linked to water quality. In addition to the combined effects of degraded water quality, the flooding that accompanied Hurricane Agnes in 1972 resulted in a prolonged period of high suspended sediment loads at a critical time of year for SAV growth. The combination of stressors had devastating effects on the SAV acreage baywide, and few areas have recovered to their 1930's- 1950's levels.

SAV Restoration in the Chesapeake Bay

SAV is widely recognized as an aquatic habitat vital to the health of Chesapeake Bay, and its restoration has long been a goal of the U.S. Environmental Protection Agency's Chesapeake Bay Program (CBP) and its partners. The CBP has recently completed a "Strategy to Accelerate the Protection and Restoration of Submerged Aquatic Vegetation in the Chesapeake Bay". One of the goals of this strategy is to plant or reseed 1,000 acres in strategic locations by December 2008.

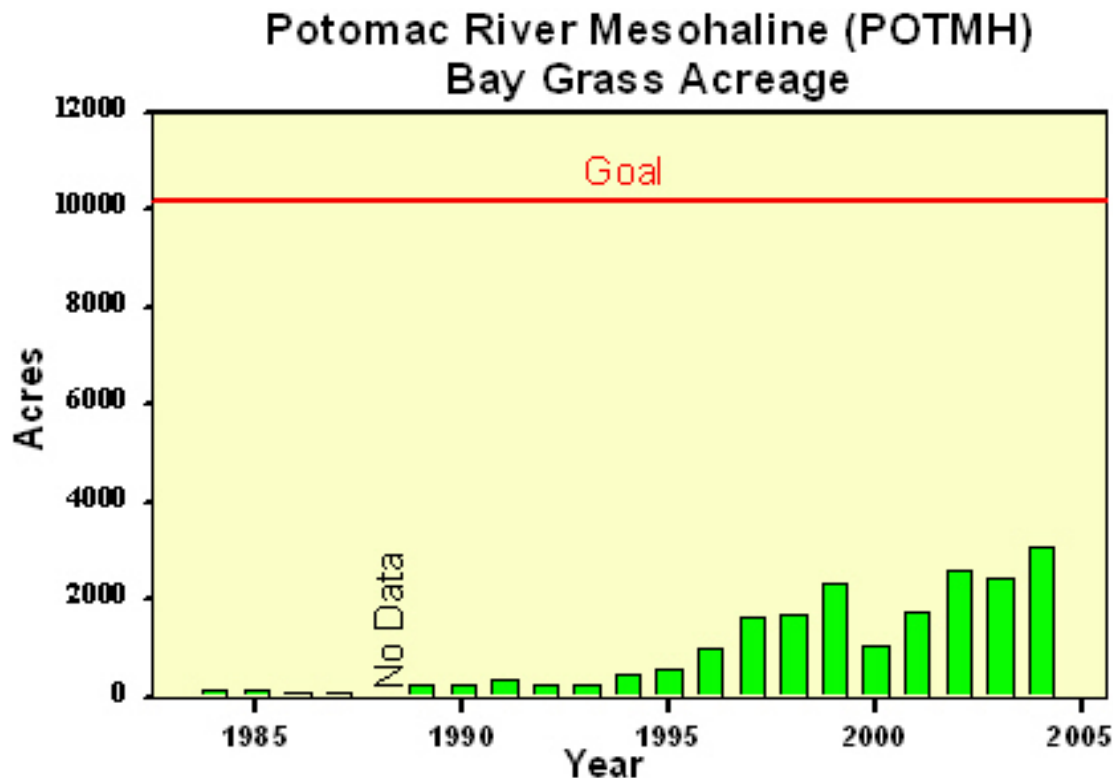


Figure 1. SAV acreage in the mesohaline portion of the Potomac River.

SAV acreage in Chesapeake Bay was estimated to be approximately 72,935 acres in 2004, less than 40% of the CBP's 185,000 acre SAV goal. Even the auspicious goal of planting 1,000 acres by 2008 will provide only small progress toward the baywide goal. However, it is recognized that there are regions within the Chesapeake Bay in which habitat conditions are suitable for SAV growth, but SAV has not recovered due to a lack of adequate seed or propagule sources. By identifying and strategically planting or reseeding beds in these areas, it is expected that these beds would serve as a seed source to accelerate natural revegetation.

Eelgrass in Restoration

Eelgrass is identified in the CBP's SAV Protection and Restoration Strategy as one of the two species with the greatest promise for large-scale restoration in Chesapeake Bay. Eelgrass meadows are highly productive components of estuarine and coastal systems and support large and diverse faunal assemblages (Thayer et al., 1984). Eelgrass plants filter and absorb nutrients from the water column (Short and Short, 1984), provide sediment stabilization (Ward et al., 1984) and baffle wave energy (Fonseca and Fisher, 1984) thereby reducing erosional forces and protecting adjacent shorelines (Christiansen et al., 1981). Eelgrass

biomass production serves as a major component of the detrital food chain (Thayer et al., 1984).

As Eelgrass is locally extinct in several areas of Chesapeake Bay, eelgrass restoration has been ongoing in Chesapeake Bay since 1980. Experiments have been performed with three different restoration techniques : 1) shoots with sediments intact, (2) seeds, and (3), shoots with bare roots. This study compared the cost effectiveness of using of seeds or adult plants for restoration in the Potomac River.

In the past, there have been a wide variety of small-scale (less than 1 acre) SAV planting, transplanting, and reseeding efforts in Chesapeake Bay that have generally met with poor success. The consensus among SAV researchers is that this is due primarily to two factors. First, bed size has been too small to afford self protection. Water clarity improves significantly within a few meters of the edge of the bed. Large beds are capable of self-protecting the core of the bed, while allowing the fringes to die back during periods of poor water clarity. Large beds are also better able to withstand damage by predators, such as mute swans (*Cygnus olor*) and cownose rays (*Rhinoptera bonasus*). Second, many previous projects have suffered from improper siting. Restoration sites have typically been selected for convenience and practicality rather than where habitat assessments and test plantings have indicated suitable areas where SAV restoration is likely to be successful.

To address these issues, the SAV Protection and Restoration Strategy calls for large-scale projects that are implemented over the course of five years. The first two years of the project are devoted to site selection, which involves applying existing habitat information to identify general areas suitable for restoration followed by test plantings at specific sites. Once the sites are selected, large-scale planting or reseeding is spread over a three-year period to minimize impacts from adverse environmental conditions in any single year.

Submerged Aquatic Vegetation Restoration in the Potomac River

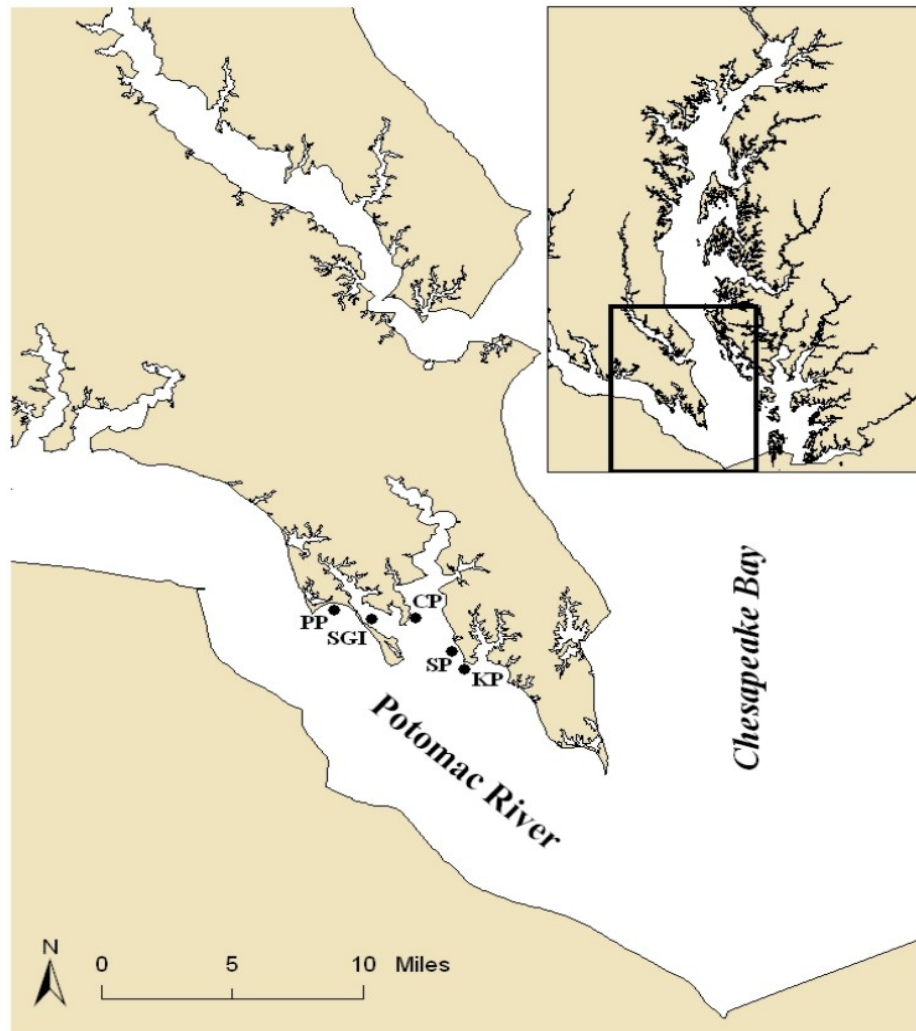


Figure 2. Map of Potomac River with restoration sites (inset, map of Chesapeake Bay). Cherryfield Point (CP), Piney Point (PP), Sage Point (SP), St. George Island (SGI), and Kitt's Point (KP).

The Potomac River is the largest river in Maryland, with a drainage area of 14,679 square miles in four states. The majority of the Potomac basin's land area is covered by forests (57.6%), followed by agriculture (31.8%), water and wetlands (5%) and developed land (4.8%, Potomac River Basin Summary, DNR website). As a large tidal river, the Potomac has significant freshwater (0 ppt salinity), oligohaline (0.5-5 ppt), and mesohaline (5-18 ppt) reaches, each with their own unique water quality attributes. SAV coverage in the tidal fresh portion has increased from a low of 1,134 acres in 1984 to 2,410 acres in 2004, approximately 55% of the 4,368 acre CBP goal. The oligohaline section during

the same time period increased from 429 acres to 3,734 acres, exceeding the 3,721 acre goal in that reach of the river. Although the mesohaline section of the river increased from 109 acres in 1984 to 3,401 acres in 2004 (Fig. 1), this is only 33% of the 10,173 acre goal, the lowest attainment by far of the three segments (Orth et. al 1985, Orth et. al 2005). This is likely due to the fact that eelgrass, once a dominant species in the area, has not been documented in the Potomac River for decades.

The Maryland Department of Natural Resources (DNR) has developed a five year plan to conduct large-scale eelgrass restoration on the Potomac River. This plan represents a synthesis of restoration work already conducted and a variety of new technologies that will maximize the acreage that can be restored. The effort will focus primarily on the use of seeds for restoration, and will compare the effectiveness of two different broadcast methods to determine the most efficient and productive way to achieve the bay wide restoration goal of 1,000 acres by 2008. At the same time, DNR will compare the effectiveness of the seeding with large-scale restoration using vegetative shoots in a side by side comparison. The project will also test the effectiveness of depositing seeds in different seasons using several techniques. This will allow for a direct comparison between seeds vs. adult shoots, as well as the effectiveness using spring seed bags vs. fall seed dispersal.